(12) UK Patent Application (19) GB (11) 2 232 954 (13) A

(43) Date of A publication 02.01.1991

(21) Application No 8136054.7

(22) Date of filing 30.11.1981

(30) Priority data
(31) 3048367 (32) 20.12.1980 (33) DE

(51) INT CL[4]
B65H 81/06

(52) UK CL (Edition K)
B8G G1B G1D G4

(56) Documents cited
None

(58) Field of search
UK CL B8G
NO SEARCH POSSIBLE

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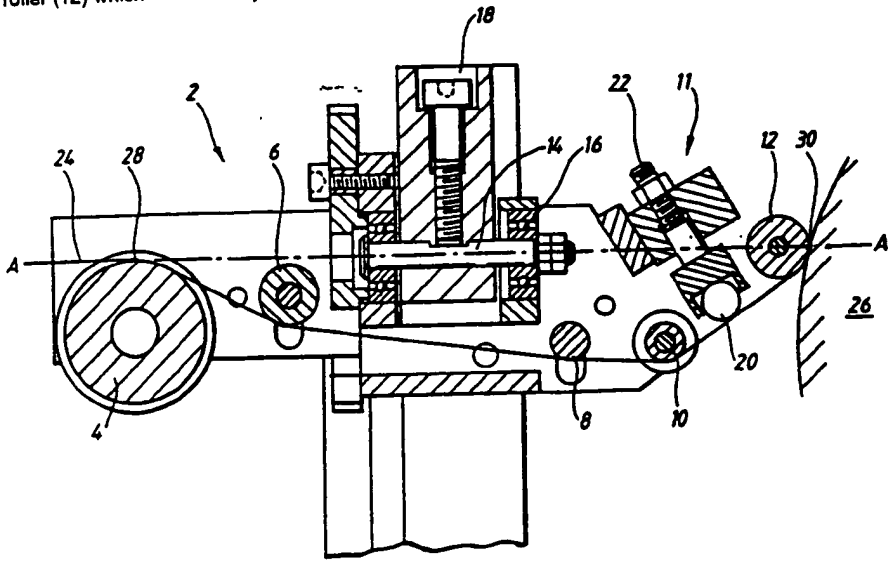
(54) "Producing thin walled fibre packages"

(57) In a method of producing thin walled carbon fibre packages, there is used a device having a convex surface on a spherical cap or ball (20) which penetrates a thread or sliver (24) of impregnated carbon fibres which extends in flush alignment and is composed of parallel, adjacent individual fibres, so as to spread out the sliver (24) to a required width. The width of the sliver (24) is determined by the depth of penetration of the ball (22) into the run of the sliver and is maintained by a finish roller (12) which rests directly on the winding mandrel (26).



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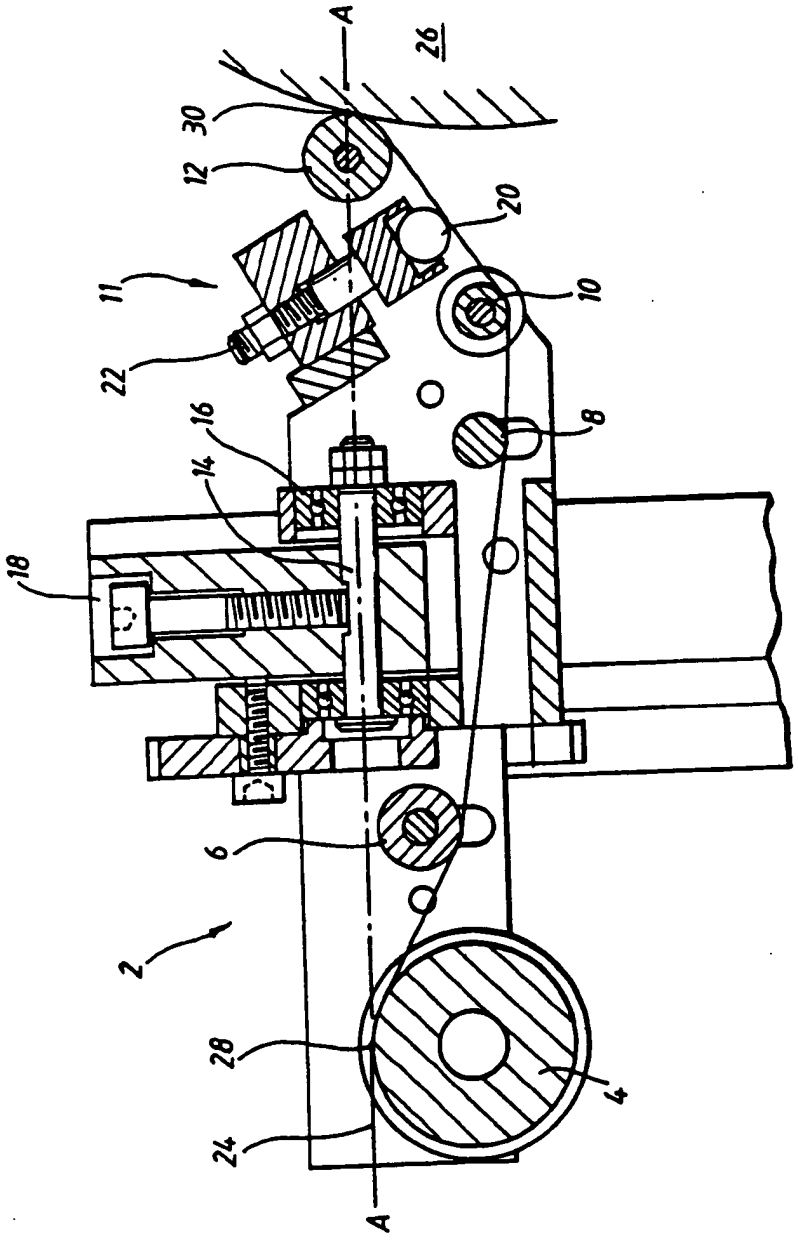
The specification was originally filed in a foreign language.
At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy

P.U. Original



A method of producing thin-walled rotationally symmetrical fibre packages from impregnated fibre materials

The invention relates to a method of and an apparatus for producing thin-walled rotationally symmetrical fibre packages of very thin wall thickness and regular distribution of fibres drawn from impregnated fibre materials.

Fibre materials are processed by the pre-preg technique or the wet technique in order to produce fibre structures. Where the wet technique is concerned, a sliver is evenly impregnated in resin and wound onto a basic former. Where this technique is concerned, structure density and fibre content depend upon the geometry of the sliver. Since a sliver consists of a vast number of individual fibres and since the sliver in most cases is uneven when it emerges from what is known as the thread eye of a machine, in previous winding methods, attainment of an homogeneous and stable structure has required a relatively large number of layers. The multiplicity of layers needed results in the wall thickness of the structure and thus also the economy is affected.

Particularly in the case of carbon fibre structures in which the cost of the fibres is considerable, it is therefore necessary to develop production methods which, with ptimally minimal usage of

fibre, provide the very best quality so that fibre packages can be economically produced.

The thin-layer technique is such a method. With this method, the structure is built up very homogeneously from thin fibre layers having a high fibre content so that they achieve the desired stability already at lesser wall thicknesses than with conventional winding methods.

The object of the invention is particularly concerned with the production of carbon fibre tubes for use in gas ultra-centrifuges. The technique described hereinafter can, however, in principle also be used for electric motors, generators or other high-speed machines where rotationally symmetrical fibre packages are required which have a high structural strength and minimal imbalance distribution.

It is an object of the invention to produce a rotationally symmetrical fibre package with a high fibre content, with an homogeneous distribution of fibres and matrix material. Further objects are the gentle processing of the fibres at a high winding speed, full exploitability of the useful length by having short feed areas on the mandrels, the production of all winding angles between 0 and 90° and optimum form accuracy and even distribution of masses in the material being wound.

A further object is not to have to consider the thread eye size in the thread delivery programme.

It is from these objects that the general object of the invention is derived, which resides in spreading the sliver, for instance of carbon fibres, out flat after it has passed through the impregnating bath and in depositing it on the winding mandrel in an even layer of c nstant thickness and width.

According to the invention, this problem is resolved in that a machine element having a convex surface penetrates a sliver extending in a flush alignment and consisting of parallel and adjacently disposed individual fibres, spreading the sliver out thereby to any desired width. Advantageously, the convex surface comprises a sphere or spherical cap and the depth of penetration of the sphere into the run of the sliver is variable.

The sliver is brought to the desired width by a suitable disposition of guide roller and a subsequent spherical surface and by means of a spring mounted finish roller of adjustable contact pressure, the sliver is then deposited on the surface of the winding mandrel. As a result of this measure, the width attained on the sphere is maintained during and after deposition, which means that very thin layers of high fibre content and an even thorough impregnation of the sliver can be achieved substantially independently of the winding speed and tension in the sliver.

Further developments of the invention are objects of the subclaims.

The invention will be explained in greater detail hereinafter with reference to an embodiment.

The sole drawing shows a cross-section through a depositing apparatus according to the invention for producing thin-walled rotationally symmetrical fibre packages consisting of impregnated carbon fibres.

Mounted or fixed in a housing of which the cross-sectional view in Fig. 1 shows only a wall 2, are a thread feed roller 4, an intermediate roller 6, a further intermediate roller 8, a guide roller 10, an adjustable feed arrangement 11 as well as a thread pay-out roller 12.

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The housing with the aforementioned components is pivotabl about an axis A-A c nstituted by an arb r 14 mounted in the housing by means f a ball-bearing 16. By means of a screw 18 which acts upon the arbor 14, it is possible to adjust and lock the pivoted position of the housing. The adjustable feed arrangement 11 carries at its front end a ball 20 (or a spherical cap) which by means of a threaded bolt 22 can be advanced to a greater or lesser degree. The peculiar features of the device reside then in the structural details to be described hereinafter in relation to the thread run.

The thread (sliver) is identified by reference numeral 24. It enters the housing via the thread feed roller 4, is guided over roller 6, passes to roller 8 and thence to guide roller 10 and via sphere 20 to the thread finish roller 12, from which it is passed over to a winding former 26. Thread feed point 28 and thread delivery point 30 which coincides with the point of deposition, lie on the pivoting axis A-A of the apparatus.

As a result, during all winding tasks, the sliver 24 is fed to the winding mandrel 26 always via the same point 30. This corresponds to a thread eyelet of diameter 0. As a result of this arrangement, even with a small lay-on angle , the sliver is in the path which precedes the depositing means, and is not rotated in the depositing means.

The thread is spread out by the combination of guide roller 10, sphere 20 and thread finish roller 12, the degree of spread being determined by the depth of penetration of the spherical surface 20 into the run of the thread. Variations in thread tension have no effect on the functioning of this apparatus.

Once achieved, the width of the sliver 24 is maintained by the finish roller 12 which rests directly n the winding mandrel 26.

The pressure of application of the device is adjustable and makes it possible to smooth out and equalise the surface and also to roll out any excess resin, so making it possible to produce wound packages with more than 70% by volume of fibre with optimum impregnation, and substantially compensates for any fluctuations in resin content in the sliver supplied to the apparatus. Details of the pivoting and pressure-applying mechanism are not shown.

The depositing apparatus makes it possible to deliver thread always to the same quality with winding angles between + $0^{\circ}/90/-0^{\circ}$.

A known belt clearer control system makes it possible to adapt the depositing arrangement to the particular winding angle involved.

One sheet of drawings

Patent Claims:

1. A method of producing thin-walled rotationally symmetrical fibre lap formers from impregnated carbon fibres, characterised in that a machine element having a convex surface (20) penetrates a sliver (24) extending in a flush alignment and consisting of parallel and adjacently disposed individual fibres, spreading the sliver (24) out thereby to any desired width.

2. Apparatus for carrying out the method according to Claim 1, characterised in that the machine element which has a convex surface is a sphere or spherical cap.

3. Apparatus according to Claim 1, characterised in that the depth of penetration of the sphere is variable.

4. An apparatus for carrying out the method according to Claim 1, characterised by a lap device consisting of a guide roller and a delivery roller (contact roller) which delivers the sliver to a winding mandrel surface and between the two fixed spheres, the winding mandrel surface plunging into the connecting line formed by the sliver between the two rollers and so contacting the sliver that the latter is opened out to a greater width.

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5. A winding device according to Claim 4, characterised in that a sliver intake roller which takes up the resin impregnated sliver is, at its pick-up point, flush with the point of application on the finish roller and in that this line of alignment forms an axis about which the winding device is pivotally mounted.

6. A winding device according to Claim 5, characterised in that between it and its attachment on a rigid frame there is a spring element so that the finish roller deposits the sliver on the winding mandrel with an adjustable application force.

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Amendments to the claims have be n filed as follows

CLAIMS:

1. A method of producing a thin-walled rotationally symmetrical fibre package from impregnated fibres, wherein a machine element having a convex surface penetrates a sliver comprising parallel and adjacently disposed individual fibres extending in a flush alignment, and spreads the sliver out to a required width for processing into the package.

2. Apparatus for carrying out a method according to claim 1, comprising a guide roller and a delivery roller for delivering a resin-impregnated sliver to a winding mandrel surface and, between the guide and delivery rollers, a machine element having a convex surface which penetrates the connecting plane formed by the sliver between the two rollers and which contacts the sliver in such a manner that the latter is spread out to a required width for processing by the winding mandrel.

3. Apparatus according to claim 2 wherein the said machine element is a sphere or spherical cap.

4. Apparatus according to claim 3 wherein the depth of penetration of the sphere or cap is variable.

5. Apparatus according to claim 4, wherein a sliver feed roller which takes up the resin impregnated sliver

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is, at its pick-up point, aligned with the point of application of the sliver on a mandrel, the line of alignment forming an axis about which the apparatus is pivotally mounted.

6. Apparatus according to claim 5, wherein between the apparatus and its attachment on a rigid frame, there is a spring element so that the delivery roller delivers the sliver to a mandrel with an adjustable application force.

7. A method of producing a thin-walled rotationally symmetrical fibre package, the method being substantially as hereinbefore described with reference to the drawing.

8. Apparatus for producing a thin-walled rotationally symmetrical fibre package, the apparatus being conducted and arranged substantially as hereinbefore described and as shown in the drawing.

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